THE COMMON MEALYBUG AND ITS CONTROL IN CALIFORNIA

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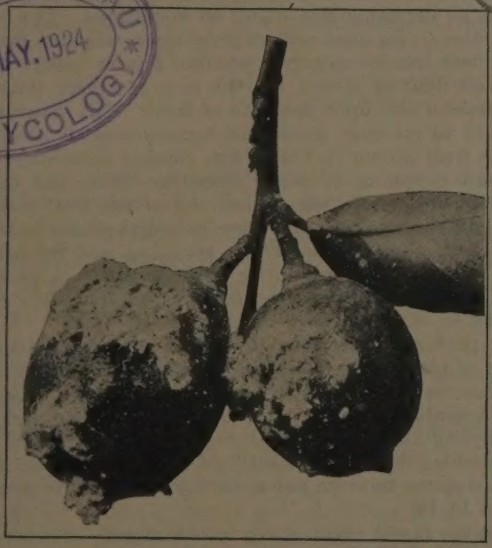

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NO ONE METHOD for the control of the common mealybug can be recommended under all conditions. The remedy or remedies to be used will depend upon whether the trees are in house lots or orchards, whether few or many, and the infestation light or severe. In the case of severe infestation it will depend also upon the kind of fruit. This insect infests oranges of all varieties, grapefruit, lemons, and all other kinds of citrus fruit grown in California, causing deformity, weakening and dropping of much immature fruit, and the discoloration and weakening of the rind of the fruit maturing.

This bulletin discusses the three remedies which have been widely used; namely, fumigation, spraying, and the artificial spread of insect enemies, points out the sphere of usefulness of each method, and shows, on pages 14–15, how they may be combined so as to secure complete control.

An important part of the procedure recommended is the banding of trees with a mixture consisting of sulphur and a sticky material used to protect trees from insects. This keeps off the Argentine ant and other ants which attend and foster the mealybug and hinder or prevent the good work of insect enemies which otherwise might hold it in check. The method of preparing the mixture and applying the bands is described on pages 12–14.

Where the insect enemies are few or absent, or where they are themselves heavily parasitized, the trees should be sprayed or fumigated, and colonies of effective enemies should be introduced.

THE COMMON MEALYBUG[1] AND ITS CONTROL IN CALIFORNIA.

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FAILURE of control methods against the common mealybug in California, together with its continued spread and the recent severe outbreak at Uplands, Cal., of a previously unknown species,[2] has caused mealybugs to be probably the most feared insect pests of citrus fruits in southern California to-day. The common mealybug is reported as destructive in Los Angeles, Orange, Santa Barbara, San Diego, and Ventura Counties. Fortunately, however, only a small percentage of the citrus acreage in these counties is now infested by this insect.

The common mealybug is of world-wide distribution and omnivorous habits. It appears first to have been reported in California as an orchard pest near Los Angeles more than 30 years ago, and subsequently came to notice in Paradise Valley, San Diego County. Its sporadic outbreaks continued to be of mere local concern until an extensive and severe infestation appeared in Ventura County in 1907-8, simultaneously with new but lesser areas of infestation in Los Angeles, San Diego, and Orange Counties.

NATURE OF INJURY AND HOST FRUITS PREFERRED.

A severe infestation of the common mealybug is well illustrated in figure 1 and in the illustration on the title-page. Immature fruit may be deformed or may become so weakened that it drops. Maturing fruit is frequently discolored, resulting in a high percentage of culls or fruit of low grade. The cottony secretion covering the egg masses is unsightly, and the sooty mold which develops in the honeydew exudations necessitates washing the fruit. Abnormal decay

[1] *Pseudococcus citri* Risso. [2] *Pseudococcus citrophilus* Clausen.

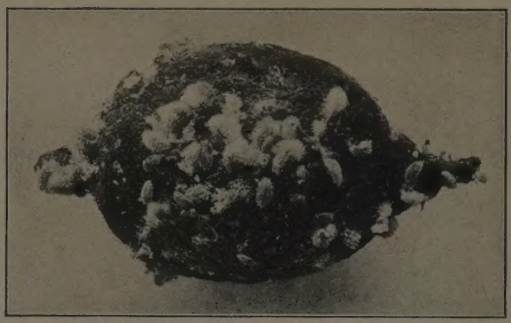

FIG. 1.—Lemon infested with the common mealybug.

usually follows the washing of this rind-weakened fruit. A severe infestation may result in partial or even complete defoliation of the trees. The lemon, grapefruit, and navel orange are preferred host fruits, although other varieties may be attacked severely.

CHARACTERISTICS AND LIFE HISTORY.

An idea of the superficial appearance of the common mealybug may be obtained from figure 2. The body of the insect is covered with a white waxy secretion, which is most pronounced in a bordering fringe of short filaments. The female retains the same general appearance through all stages of development from larva to adult. The male in its early stages is very similar to the female, but about four weeks after hatching it forms a cocoon, and from this it emerges, from 10 days to two weeks later, as a very small and delicate, light olive-brown, winged, gnatlike adult. Reproduction takes place from eggs deposited in a cottony sac secreted by the mature female. The number deposited depends on the size of the insect and varies from less than a hundred to more than a thousand, the average production of a female mealybug on green fruit being between 300 and 600 eggs. The length of a single generation on orange trees under the climatic conditions of Pasadena, Cal., during 1914–1916, varied from a minimum of 36 days during the summer to approximately six months during the winter. There are three more or less distinct generations a year on the citrus trees of southern California.

As a rule the infestations in the late winter and spring are so light as to escape notice, but later the crowding of the young insects on the small fruit, followed by the production of egg sacs in early summer, readily reveals the presence of the pest, and the maximum infestation and injury usually come in the early autumn with the second generation of mealybugs.

CONTROL OF THE MEALYBUG.

Three methods of control—fumigation, spraying, and the colonization of natural enemies—have played an important part in combating the mealybug on citrus trees and have been esteemed variously as the most promising. The studies carried on in southern California by this department indicate that no one of these control methods is applicable or preferable under all conditions of infestation, but by proper combination of these methods, and with the addition of banding to exclude ants, satisfactory control may be accomplished.

FUMIGATION.

Fumigation with hydrocyanic-acid gas as generally practiced for the black and red scales is a failure against mealybugs. No instance has been observed where the usual commercial treatment of an infested orchard with this gas has controlled this pest. Although records taken within a few weeks after fumigation have shown a reduction of the mealybug, such reduction was found invariably to be due largely to the action of natural agencies and doubtless would have occurred even though the trees had not been treated—a consideration seldom taken into account by the orchardist or commercial operator.

FIG. 2.—A group of common mealybugs. Enlarged about 9 times.

Table I sets forth the general results of experiments made to test the value of fumigation. The work was performed during the years from 1909 to 1917, under the climatic conditions normal to orchard fumigation in southern California.

TABLE I.—*Results of fumigation with hydrocyanic-acid gas against the common mealybug.*

A. 8-OUNCE U. S. ARMY DUCK TENT.

SINGLE CHARGE.

Dosage schedule.	Exposure.	Results.
No. 1[1]	1 hour	Small percentage killed. Commercially ineffective.
Two and three times No. 1.	do	85 to 95 per cent killed.

REPEATED CHARGE UNDER SAME TENT.

First charge.		Second charge.		Results.
Dosage schedule.	Exposure.	Dosage schedule.	Exposure.	
No. 1	30 minutes	No. 1	30 minutes	Small percentage living.
One and one-half times No. 1.	do	No. 1	1 hour	99 per cent killed.
No. 1	1 hour	No. 1	do	Do.

B. GAS-TIGHT TENT.

Sodium cyanid per 100 cubic feet.	Exposure.	Results.
1 ounce	1 hour	Sometimes a few living; usually all killed.
1½ ounces	do	All killed.

C. GAS-TIGHT BOX OF 100 CUBIC FEET CAPACITY.

¾ ounce	45 minutes	A number living.
¾ ounce	1 hour	A few living.
¾ ounce	2 hours	Sometimes a few living.
¾ ounce	4 hours	All killed.
1 ounce	45 minutes	Usually a few living.
1 ounce	1 hour	All killed.

[1] This schedule is given on page 34 of Bulletin No. 90 of the Bureau of Entomology, U. S. Department of Agriculture.

These results show the ineffectiveness of single-dosage fumigations under army duck tents, even where excessive dosages are used. Repeated charges give better results but can not be recommended except in the case of a limited number of trees where other control measures are not readily available, or where cost and possible injury are secondary to immediate control. Since 8-ounce United States Army duck retains hydrocyanic-acid gas better than any other cloth of which fumigation tents are constructed at present, results equally

poor in comparison with those tabulated are to be expected under drill or double-filled duck covers.

Treatment under gas-tight tents is eminently successful from the standpoint of general control, it being possible to secure complete eradication on a small number of trees, and such treatment would be recommended in preference to any other means of artificial control but for the fact that no gas-tight tenting material practical for commercial usage is known at present. It is to be hoped and expected that a suitable gas-tight cloth will be forthcoming in the future. The dosage should be 1 ounce of sodium cyanid to each 100 cubic feet of space beneath the tented tree; for eradication, 1¼ ounces.

Citrus trees in dormant condition during the winter months will withstand safely a dosage as high as 1¼ ounces of sodium cyanid to 100 cubic feet of space under gas-tight covers. Heavy, repeated dosages under ordinary commercial tents have been used at this time with little damage to the trees. It is unsafe, however, to apply such concentrated gas to orange or grapefruit trees during the growing season.

Eradication of the mealybug can be effected in a gas-tight box or room with a dosage rate of 1 ounce of sodium cyanid to each 100 cubic feet of space.

SPRAYING.

RECOMMENDED SPRAY FORMULAS.

More than 100 different sprays have been tried against the mealybug, including insecticides formerly used and others developed during this investigation. Several preparations, including the resin wash and a 2½ per cent paraffin-oil emulsion, have given fairly effective results; but two new sprays, cresolated distillate emulsion and soap-powder emulsion, are recommended as best measuring up to orchard requirements in mealybug control. The formulas for the preparation of these sprays are given below.

CRESOLATED DISTILLATE EMULSION.

Distillate (28° Baumé)	gallons	2¾
Liquor cresolis compositus, U. S. P.	quarts	1¾
Liquid fish-oil soap	quart	1
Soap powder (sodium carbonate 40–60 per cent, caustic soda 40–60 per cent)	pounds	3
Water to make	gallons	100

Preparation.—When the bottom of the spray tank is covered with water, start the agitator and sift in the finely ground soap powder, which dissolves while the tank is filling. Prepare the stock by first measuring the distillate, then pour the liquor cresolis compositus into the distillate and stir. Pour into the liquid soap twice as much of the foregoing mixture as of the soap and beat with a paddle until of uniform consistency. Then add remainder of mixture and stir thoroughly, after which the preparation is ready to be poured into the spray tank.

This spray has been used with success for more than a year and is recommended as the preferred insecticide for mealybugs. It has been applied to a very large variety of plants during the winter season without injury. Oranges and lemons are treated safely, though grapefruit has been known to be stained slightly. The grade of distillate is very important, and only that of a gravity approximating 28° Baumé should be purchased. This is an untreated black oil, very distinct from the stove distillate (32°–34° Baumé), which is commonly used for spraying. The cost of cresolated distillate emulsion is about 1½ cents a gallon.

SOAP-POWDER EMULSION.

Distillate emulsion[1]	gallons	5
Soap powder	pounds	10
Water to make	gallons	100

Preparation.—When the bottom of the spray tank is covered with water, start agitator and sift in the finely ground soap powder. The distillate emulsion is added when the tank is almost filled.

Soap-powder emulsion is effective against the mealybug as well as against citrus scales. It is more injurious to the foliage than cresolated emulsion, however, and may cause moderate or even severe dropping of the leaves unless applied under favorable climatic conditions. (See "Season for spraying," p. 9.) The cost is about ¾ cent a gallon.

HOW TO SPRAY A TREE.

Trees first should be pruned of all dead wood and opened up so as to allow the ready use of the nozzle on the inside. In spraying for mealybug control the results accomplished are quite as dependent upon the method of application as upon the insecticidal properties of the material used. The upper, or dorsal, surface of the mealybug is tough and resistant to most commercially usable dips and sprays, the place of greatest vulnerability appearing to be a series of tubes which lie beneath the fringe of wax. This protective fringe, which is very resistant to most insecticides, must be removed by the spray to insure quick destruction of the insect; and to effect this removal careful treatment with a driving spray is required.

A power machine capable of maintaining 200 to 250 pounds pressure should be used. A very satisfactory type of nozzle is shown

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[1] Formula for distillate emulsion:

Distillate (28° Baumé)	gallons	20
Liquid fish-oil soap	do	4
Hot water	do	16

Pour hot water into spray tank. Start agitator, then add soap. Next slowly pour in distillate. Pump back into itself through nozzle for 20 minutes, after which pump through fine nozzle into storage tank. This emulsion keeps indefinitely.

in figure 3. The rods for spraying the inside and lower parts of the trees should not exceed 6 feet in length.

Mealybug infestation is confined in large part to the fruit, especially that toward the inside of the tree. It is recommended that the inside of the tree be sprayed first, starting at the lower part and moving upward, and then finishing over the outside of the tree. Especial effort should be made to spray the top of the tree, where the insects are most likely to escape treatment. Trees more than 10 feet in height should have their tops sprayed from a platform on the sprayer or from a light tripod ladder which can be carried from tree to tree. The nozzle should be moved rapidly about the tree, the spray being directed against both sides of the leaves, against the

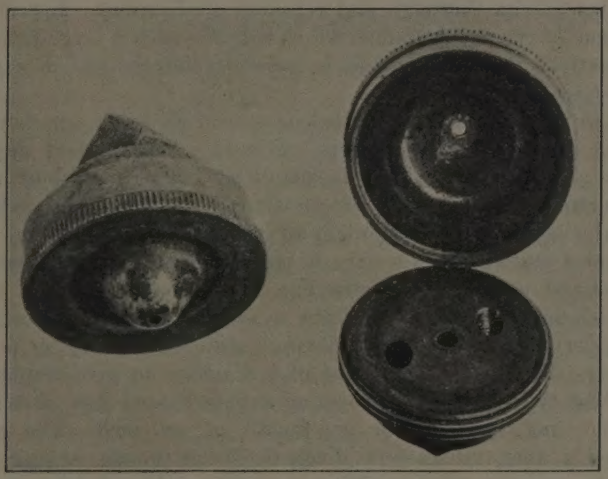

FIG. 3.—A type of nozzle well adapted to mealybug spraying.

fruit from at least two directions, and in all crevices which may harbor mealybugs. Thoroughly to spray a citrus tree 10 to 15 years old usually requires fully 20 gallons of material.

SEASON FOR SPRAYING.

Insecticidal sprays of the strength required to destroy the common mealybug may be applied safely to citrus trees in California only during the cool months of the year, when the fruit is either maturing or has been picked. This season generally extends from November to April, though the months of greatest plant resistance to sprays are December, January, and February. It is unsafe to apply the insecticidal sprays advocated in this bulletin when the temperature is above

80° F. or during the summer when the trees are laden with immature fruit. Should it appear advisable to employ a spray during the summer, water under pressure should be used, as this can be applied safely, even when the highest summer temperatures prevail.

WATER SPRAYING.

An increasing number of growers are using successfully water under pressure so as to dislodge the mealybugs forcibly from citrus trees. This method of control was demonstrated in several orchards during the years 1915 and 1916, with varying degrees of success. Control of mealybugs by water spraying is practicable in the case of all citrus fruits excepting possibly the navel orange, but its success depends on thorough and repeated applications. Especially is this true of the navel orange, which requires such a large number of applications that the method is generally impractical in extensive and severe infestations.

Water has one important advantage over all other sprays in that it may be used with safety in unlimited quantities at any time of the year, thus affording a means of combating mealybugs during the summer months when practically all insecticides of value are too injurious to fruit and foliage to justify their application.

Several matters have a very important bearing on the successful commercial use of water spraying. In orchards the cost can be reduced materially by installing a system of piping, the power being derived from the water main, a stationary pump, or a power sprayer. The piping should be of a diameter to give ample force. The best type of nozzle allows an uninterrupted flow through an aperture not larger than one-fourth of an inch. The writers devised a very satisfactory direct-discharge nozzle having a rectangular opening 6 by 2 millimeters and capable of delivering 6 to 7 gallons a minute under 100 pounds pressure. The common garden type or a ¼-inch fire nozzle, however, will serve the purpose. Nozzles with small openings, as those of the Bordeaux type, are unsuitable for water spraying, as the stream of water will strip the leaves and cut off fruit. The tops of the trees should be sprayed from a ladder. Twenty to thirty minutes are required for spraying thoroughly a tree 10 to 15 years old.

CONTROL BY NATURAL ENEMIES.[1]

No important citrus insect pest in California seems to be attacked by more natural enemies than the mealybug, and efficient control of

[1] The more effective enemies of this species, including both predators and parasites, given in the order of their importance, are: *Sympherobius barberi* Banks, *S. californicus* Banks, *Hyperaspis lateralis* Muls., *Cryptolaemus montrouzieri* Muls., *Chrysopa californica* Banks, *Leucopis bella* Loew, and *Paraleptomastix abnormis* Girault.

the mealybug by these natural enemies is often noted. For example, one severely infested orchard was observed to be cleaned in less than two months to an extent satisfactory in commercial control by two species of predatory brown lacewing flies.[1] Other groves have enjoyed similar respite from mealybug injury through the activity of these brown lacewings, aided by one or the other of two species of ladybird beetles.[2] Undeserved credit is often given to insecticides, in the case of orchards that have contained these natural enemies in large numbers at the time of spraying or fumigation, while in fact the mealybugs have been destroyed by these predatory enemies unobserved by the orchardist or operator. The natural enemies are most efficacious during the autumn and early spring.

RELATION OF ANTS TO NATURAL CONTROL.

Since the mealybug is beset with so many efficient natural enemies, it has been the cause of considerable wonder that the pest is not more generally kept in check. The infestation may be reduced during the autumn or spring to a point bordering on control or even eradication, yet it is a matter of common observation in some localities that in spite of these conditions one severe infestation follows another year after year. This failure of the natural enemies to hold the mealybug in check throughout the year has been found to be due mainly to the presence on the trees of large colonies of ants, the Argentine ant [3] being the greatest offender. The experimental work reported in this bulletin has been confined to the Argentine ant, which has been observed to carry living mealybugs, to destroy and carry off the larvæ and eggs of natural enemies, to interfere with the free movement about the tree of certain beneficial insects, and by their constant attendance upon the mealybugs to prevent normal egg laying and feeding of the adult parasites and predatory enemies.

Remarkable results have been secured by keeping the Argentine ant off of trees infested with mealybugs by banding with a sticky mixture. In Los Angeles County during 1915 and 1916 trees that when first freed from ants were infested severely with the mealybug became commercially clean, without exception, within a period of six weeks to three months. The mealybug remained under control throughout the year or during the period of the experiments, while trees in adjacent check rows only a few feet away continued to be severely infested. The natural enemies responsible for this control were the two brown lacewings and a ladybird beetle.[4]

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[1] *Sympherobius barberi* Banks and *Sympherobius californicus* Banks.
[2] Either *Hyperaspis lateralis* Muls. or *Cryptolaemus montrouzieri* Muls.
[3] *Iridomyrmex humilis* Mayr.
[4] *Hyperaspis lateralis* Muls.

An experiment typical of many others is given in Table II.

TABLE II.—*Relation of the Argentine ant to the natural control of the mealybug. Experiments at Sierra Madre, Cal., July to October, 1916.* [*Percentage of fruit infested with the mealybug on each tree. Twenty orange trees to each test.*]

I. NO INSECTICIDAL TREATMENT.

Tree No.	1	2	3	4	5	6	7	8	9	10
Infestation at start of test, July 25. All trees frequented with ants:										
a. Check row, unbanded	100	100	94	80	34	90	100	100	91	100
b. Banded	92	96	92	86	100	73	82	75	93	100
Six weeks after start, Sept. 6:										
a. Check row, unbanded	100	92	80	91	73	100	100	86	90	100
b. Banded	1	3	2	1	15	1	2	1	.....	24
Eleven weeks after start, Oct. 11:										
a. Check row, unbanded	100	82	45	50	32	61	96	76	42	86
b. Banded	0	1	0	0	1	0	1	0	0	1

[1] Only 8 infested fruit on entire 10 banded trees.

II. TREES SPRAYED WITH WATER ON JULY 25.

Condition before water spraying, July 24:										
a. Unbanded	94	100	97	100	100	100	85	100	100	100
b. Banded	30	98	100	90	55	93	80	100	100	86
Six weeks after start, Sept. 6:										
a. Unbanded	100	95	94	99	100	98	100	59	100	94
b. Banded	2	1	9	2	1	4	14	1	3	3
Eleven weeks after start, Oct. 11:										
a. Unbanded	90	93	92	90	94	100	100	20	100	100
b. Banded	1	0	1	0	0	0	1	0	0	0

HOW TO KEEP ANTS OFF OF TREES.

To free trees of ants the ideal procedure would be to eradicate these insects from the area affected. The writers have not carried on any such tests, but the published results of work carried on by the Department of Agriculture against the Argentine ant[1] would indicate the feasibility of freeing orchards of this pest.

The procedure followed with noteworthy success in municipal control work was the distribution throughout the affected area of a poisoned sirup in a suitable container. A paraffined paper bag, with perforations for the passing of ants, containing about a gill of sirup, was used as a container for nailing to trees.

The sirup is made as follows:

Granulated sugar	pounds	15
Water	pints	7
Tartaric acid (crystallized)	ounce	½
Boil for 30 minutes. Allow to cool.		
Dissolve sodium arsenite (C. P.)	ounce	½
In hot water	pint	1
Cool. Add poison solution to sirup and stir well. Add to the poisoned sirup:		
Honey	pounds	1½
Mix thoroughly.		

[1] Barber, E. R. The Argentine Ant: Distribution and Control in the United States. U. S. Dept. Agr. Bul. 377. 23 p., 4 fig. 1916. Newell, Wilmon, and Barber, T. C. The Argentine Ant. U. S. Dept. Agr. Bur. Ent. Bul. 122. 98 p., 13 pl., 13 fig. 1913.

A number of experiments with banding in orchards infested with the Argentine ant have proved the practicability of this method of keeping trees free of ants during their active season, and this method of control is recommended (see fig. 4) as the most effective one tried. Before the band is applied the tree should be pruned so that the lowest branch is fully a foot above the ground, and all rubbish should be removed from beneath the tree and the soil cultivated to destroy all grass and weeds. The only banding material which has given satisfaction is a mixture[2] made up as follows:

Finely powdered flowers of sulphur	part by weight 1
Commercial tree-banding sticky material	parts by weight 6

The two ingredients are mixed together thoroughly with a wooden paddle until of a uniform color and consistency. That possible injury may be avoided, this is not applied directly to the bark, although direct application of the commercial sticky tree-banding material alone has never been noted in California to affect citrus trees seriously. First coat the trunk with a thin layer of paraffin and apply the mixture of sulphur and sticky tree-banding material over this. Paraffin that has a high melting point is preferable, and it is applied with a brush while melted. It hardens almost immediately, after which the mixture just referred to can be applied in a band about 5 inches wide and almost one-fourth inch thick. A single application of this material has kept trees free of ants for several months during warm weather.

FIG. 4.—Keeping ants off citrus trees. A 5-inch band of sulphur and commercial sticky tree-banding material over a wider coating of paraffin.

[2] Compounded by Mr. J. R. Horton of the Bureau of Entomology, U. S. Department of Agriculture. (See Horton, J. R. Some weatherproof bands for use against ants. *In* Mo. Bul. Cal. State Com. Hort., v. 5, no. 11, p. 419–421. 1916.)

Ants that are on trees at the time of banding usually drop off within a day or two unless nests are in the trunk or branches. If nests are present, however, they should be destroyed by applying pyrethrum or some other ant powder, or with a fine spray of gasoline from a plumber's torch, or with cresolated emulsion applied with a 3-gallon compressed-air sprayer. This should be done early in the morning, while the ants are least active.

Inspection should be made weekly for the discovery of reinfested trees, the bands being renewed where necessary and the branches of the trees kept from coming in contact with weeds or the ground.

GENERAL RECOMMENDATIONS.

In view of the success secured in the foregoing experiments in controlling the mealybug by keeping ants off of the trees, the impression might be conveyed that banding alone is all that is necessary to keep orchards commercially free of this destructive pest. Under present conditions this would probably prove true in most cases; nevertheless, two important factors must be kept in mind when a general scheme of control for the common mealybug in southern California is under consideration: (1) The possible scarcity or absence of effective beneficial insects in the infested orchard and (2) heavy parasitism of the beneficial natural enemies themselves in some localities at certain seasons of the year. Control of the mealybug under either of these conditions could not be effected quickly except by spraying or other artificial control, unless it should be possible to introduce promptly large colonies of effective natural enemies.

General recommendations for control are given below, and it is believed that complete success will result if they are followed closely in all details. Frequent examinations to detect ant reinfestation must be made, and colonization of natural enemies, where not present already in noticeable numbers, is essential. The trees should be sprayed wherever the conditions demand it.

PROCEDURE RECOMMENDED FOR THE CONTROL OF THE COMMON MEALYBUG.

TREES IN ORCHARDS.

1. Where there are very few trees.
   - *a*. Prune heavily for spraying, with lowest branches at least 1 foot above ground.
   - *b*. Band trees with sulphur-sticky mixture and keep them free of ants.
   - *c*. Attempt eradication by spraying with cresolated emulsion or by fumigation under a gas-tight tent.
   - *d*. Inspect weekly. If living insects are present, respray or refumigate until they are eradicated.

2. Where there is a light general infestation.
   A. Where no trees are severely infested.
      1. Pick navel fruit, including all culls and off bloom, before March 1.
      2. Band trees with sulphur-sticky mixture, preferably in February or March. Free trees of ants.
      3. Introduce large colonies of the four most useful insect enemies,[1] if these are not present in noticeable numbers. This should be done preferably in March or April, but introduction can be continued throughout the season, if necessary.
      4. Inspect weekly for ant reinfestation.
      5. Spray with water during summer, if infestation becomes severe.
   B. Where there are a few severely infested trees in an orchard otherwise lightly infested.
      1. Such trees should have the infestation greatly reduced during the month of February, either by spraying with cresolated or soap-powder emulsion or by fumigation under a gas-tight tent. Afterwards they can be handled like the rest of the orchard, as explained in A above.
3. Where there is severe infestation.
   A. Treatment of navels, grapefruit, and lemons.
      1. *Navels and grapefruit.*—Pick all fruit, including culls and off bloom, before treatment. Leave culls and off bloom on the ground.
         Lemons.—Pick all marketable fruit before treatment.
      2. Prune heavily for spraying, with the lowest branches at least 1 foot above the ground.
      3. Following removal of fruit, spray with cresolated or soap-powder emulsion, or fumigate under a gas-tight tent, preferably in February.
      4, 5, 6, 7. The same as for *A* 2, 3, 4, and 5, respectively, in section 2.
   B. Treatment of Valencias.
      The procedure is the same as for navels, grapefruit, and lemons, except that the fruit is not picked, while the spraying should be done with cresolated distillate emulsion.

TREES IN HOUSE LOTS.

1. Pick all fruit during the winter.
2. Prune heavily and keep free from buildings, other plants, etc.
3. Fumigate with eradication dosage under gas-tight tent if available. Otherwise spray heavily with cresolated or soap-powder emulsion.
4. Band with sulphur-sticky mixture and keep free of ants.
5. Spray frequently with water if living insects continue on trees.

PREVENTING SPREAD THROUGH PICKING BOXES AND BY PICKERS.

The present localization of the common mealybug renders advisable the adoption of some means to prevent its spread to new regions through such controllable agencies as picking boxes and picking sacks. Picking boxes which have been known to carry fruit infested with the mealybug should be treated before use in uninfested

[1] *Sympherobius californicus, S. barberi, Hyperaspis lateralis,* and *Cryptolaemus montrouzieri.*

orchards. Eradication of this insect on boxes is secured by fumigation in a gas-tight room with hydrocyanic-acid gas at the rate of 1 ounce of sodium cyanid to each 100 cubic feet of space, or with sulphur at the same strength.

Dipping picking sacks, gloves, and jumpers in gasoline for five minutes will destroy all insects and eggs. As the gasoline evaporates in a few minutes, the cloth or leather will be ready for use again before the next orchard is reached.

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